



VisiFerm™ RS485-ECS Sensors

Operating Instructions

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HAMILTON®

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The user is solely responsible for the calibration, maintenance, and regular replacement of the sensors. For critical sensor applications, Hamilton recommends the use of backup measuring points to avoid consequential damage. The user is responsible for taking appropriate precautions in the event of sensor failure.

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Document History

Manual revision No.	Date of issue	Change summary
00	May 2008	The first release of the VisiFerm™ RS485-ECS Sensor Operating Instructions
03	June 2026	- Manual contents have been migrated into SCHEMA ST4 Component Content Management System (CCMS) - New layout design: Improved look and feel - All chapters and sections have been updated - The content has been restructured and revised to improve comprehensibility, usability and consistency. The threshold for the quality indicator (QI) has been adjusted to increase efficiency: Warning threshold: Changed from 40% to 10% to decrease unnecessary early warnings. Sensor replacement: The new warning recommends sensor replacement at the correct time. It does not stop the operation. Continuous measurement: The sensor gives values when the QI is less than 10%. The operation can continue. Optical cap: The QI and the 40% warning threshold remain unchanged. This change allows sensors used in low-temperature environments to display a higher QI value, thus improving operational efficiency.

Preface

VisiFerm™ RS485-ECS Sensor documentation suite

This manual is part of a documentation suite that includes the following documents:

Table 1. VisiFerm™ RS485-ECS Sensor documentation suite

Document title	Description	Manual REF
VisiFerm™ RS485-ECS <i>RS485-ECS Sensors Operating Instructions (this manual)</i>	Provides detailed information about installing and setting up the sensor, as well as additional technical information.	10151964
VisiFerm™ RS485-ECS <i>RS485 Arc Sensors – Modbus RTU Programmer's Manual</i>	This manual is intended for software programmers. It provides detailed information about the VisiFerm™ RS485-ECS RS485 Sensors Modbus RTU interface as well as general information about Modbus command structures and their implementation in the Hamilton Arc sensors family.	111004302
<i>Hamilton Arc Operating Instructions</i>	This manual provides detailed information about the Arc system which consists of the Arc sensors, the ArcAir application, accessories and their applications. The Arc sensors are designed to measure pH, dissolved oxygen, conductivity, carbon dioxide, cell density, and oxidation-reduction potential (ORP) in a liquid medium.	10071115

The latest version of the English manual, related documents, and translated manuals can be downloaded from the Hamilton Process Analytics website (<https://www.hamiltoncompany.com/process-analytics>).

Conventions used in this guide/manual

Safety messages are displayed as follows:

 **WARNING**

Alerts the user to the risk of injury, death, or other severe adverse reactions associated with the correct or incorrect use of the device.

 **CAUTION**

Alerts the user to the possibility of a problem with the device associated with its use or misuse, such as device malfunction, device failure, damage to the device, or damage to other property.

NOTICE

Emphasizes information of particular importance.

Typographic conventions

Table 2. Overview of the typographic conventions used in this manual

Typographic effect	Example	Function
Bold	Settings	Indicate the name of an icon or a button in the software/application.
	Touch the Settings tab > Measurement Settings subtab	The notation XX > XX shows the sequence of buttons to touch to open the associated window in the software/application.
Italic	<i>Operating Instructions / Quick Start Guide</i>	Indicates the names of other documents.
	<i>Moving Average: 10 / (Default) Measurement Interval: 3 (Default)</i>	Emphasizes information of particular importance.
Software graphical user interface (GUI) text	"Initialization of the correlation point has been completed."	Indicates text or message quoted directly from the software/application window or screen.
Procedural sequence	1. Step 1 in a sequence 2. Step 2 in a sequence	Organizes a sequence of actions into steps.

Typographic effect	Example	Function
Illustration number sequence	1: Identifies part/item 1 of an illustration 2: Identifies part/item 2 of an illustration	• Used in illustrations/graphics to identify the part/item for cross-referencing in a procedure or description. • It also relates to the specific part/item description in the legend table for the corresponding illustration/graphic.
Hyperlink text, for example, see Chapter 2 or see Figure 7-2	See Chapter 2 or see Figure 7-2	If you are viewing this file with PDF software, you can click on the hyper-linked text /reference number to instantly access the corresponding information in another part of this document.

Graphics or illustrations used in this manual

- The graphics or illustrations used in this manual are for illustrative purposes only.
- The colors used in the graphics or illustrations may not be an exact representation of the actual product.

In this manual:

- Some figures use callouts in a white circle with a blue border.
 - ①: These figures may have an associated legend table or may describe a single item legend in the title of the figure. Callouts may be numerical or alphabetic. Callouts are unrelated to any nearby procedures and refer only to the figures themselves and their associated legend.
- Some figures use small dark blue callouts.
 - A: These callouts show the sequence of steps. They are not related to the numbering of any associated procedure.

In tables and some descriptive text, safety messages are indicated as follows:

 **WARNING!**

 **CAUTION!**

 **NOTICE!**

The latest version of the English manual, related documents, and translated manuals can be downloaded from the Hamilton Process Analytics website (<https://www.hamiltoncompany.com/process-analytics>).

1 Introduction

This Chapter provides information about the intended use of the VisiFerm™ RS485-ECS Sensor and the operating instructions.

1.1 Intended use

The VisiFerm™ RS485-ECS sensors are intended for the measurement of dissolved oxygen (DO).

If the sensor is used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

CAUTION

Correct use of the sensor and safety limits:

- *Do not use the VisiFerm™ RS485-ECS Sensor in hazardous areas.*
- *The VisiFerm™ RS485-ECS Sensor has an internal temperature sensor (NTC 22 kOhm). Use this temperature sensor only to monitor the sensor conditions. Do not use this temperature sensor to control the process temperature.*
- *Do not use the measurement values transmitted by wireless communication to control the process.*

1.2 About these operating instructions

The VisiFerm™ RS485-ECS Operating Instructions are intended to guide users to operate the VisiFerm™ RS485-ECS Sensor in combination with the ArcAir application (version 3.11 or higher) correctly and safely. The operating instructions also describe the different components and functions of the VisiFerm™ RS485-ECS Sensor and the ArcAir application.

These operating instructions provide an in-depth description of both the hardware and software of the VisiFerm™ RS485-ECS Sensor and how to operate the sensor in a bioprocess system.

Each section introduces various parts of the system, followed by step-by-step instructions on how to operate the VisiFerm™ RS485-ECS Sensor with the ArcAir application. After reading this manual, the user should be able to install and operate the VisiFerm™ RS485-ECS Sensor with the ArcAir application.

1.3 General precautions

For safe and correct use of VisiFerm™ RS485-ECS, it is essential that both operating and service personnel follow generally accepted safety procedures as well as the safety instructions given in this document, the VisiFerm™ RS485-ECS operation instruction manual.

The specification given in the «Specification Sheet» as regards temperature, pressure etc. may under no circumstances be exceeded. Inappropriate use or misuse can be dangerous.

The lifetime of the VisiFerm™ RS485-ECS highly depends on the specific conditions of the application. Temperature, pressure, chemicals used may accelerate the ageing of both the sensor and its ODO cap. See Section 6 for replacement conditions.

Cleaning, assembly and maintenance should be performed by personnel trained in such work. Before removing the sensor from the measuring setup, always make sure the no process medium can be accidentally spilled. When removing and cleaning the sensor, it is recommended to wear safety goggles and protective gloves.

The sensor can not be repaired by the operator and has to be sent back to Hamilton for inspection.

Necessary precautions should be taken when transporting the sensors. For repair or shipment the sensor should be sent back in the original reusable packaging box. Every VisiFerm RS485-ECS sent back for repair must be decontaminated.

If the conditions described in these operating instructions manual are not adhered to or if there is any inappropriate interference with the equipment, all of our manufacturer's warranties become obsolete.

2 Safety Precautions and Hazards

This Section provides safety information and technical-related information about the VisiFerm™ RS485-ECS Sensor.

If you have questions about any of the information in this manual, contact your Hamilton Process Analytics representative or technical service personnel.

CAUTION

Safety precautions and hazards:

- *Carefully read and observe the following safety precautions and hazards before installing, setting up, and operating the sensor.*
- *Failure to observe and follow through with the maintenance procedures can affect the reliability and correct function of the system.*
- *Failure to observe the safety precautions and hazards described in this manual, improper use of the sensor, and unauthorized interference with the sensor by external devices will void all warranties provided by the manufacturer.*
- *Do not expose the sensor to corrosive media or substances. This will help to protect the sensor from deterioration.*

2.1 Operating precautions

When using the VisiFerm™ RS485-ECS sensors in process environment wear suitable protective clothing, safety glasses and protective gloves, particularly when dealing with a malfunction where the risk of contamination from spilled liquids exists. Installation and maintenance of sensors must be performed only by trained personnel. The mobile devices and sensors must be used for their intended applications, and in optimum safety and operational conditions.

Use only wired digital or analog ECS connection for the process control. The RS485 interface is designed for sensor monitoring, maintenance and service purposes.

Installation and Safety Instructions

Do not damage the PG13,5 thread and the O-ring when you install the sensor into the process. O-rings are consumable parts. Replace the O-rings regularly (at least one time each year).

Leaks or mechanical damage to the armature can occur even when you obey all safety instructions. Gases or liquids can leak without detection from seals or screws.

Before you remove the sensor from the measurement system, make sure that the process medium cannot spill.

Make sure that air bubbles or gas bubbles do not stay on the sensing element of the sensor. Bubbles can cause unstable measurement values.

Do not cause vibration, bending, or torsion on the system. Before you use the sensor, verify that the sensor configuration is correct for your application.

Failure to observe and carry out the maintenance procedures may impair the reliability and correct functioning of the measurement system.

 **CAUTION**

When unscrewing the PG 13.5 thread connection never turn the sensor at the connector head because you can loosen the ODO Cap from the sensor shaft and fluid can reach the interior of the sensor.

NOTICE

To avoid humidity problems, make sure that the ODO Cap is always attached firmly to the sensor shaft, and that the O-ring between the shaft and cap is undamaged.

You can find full details, including serial number and most important specifications, on the certificate provided with each sensor. Before use, verify that the sensor is properly configured for your application.

Make sure that following cross sensitivities and resistances of ODO Caps are respected.

Table 2-1. Cross Sensitivities and Resistances of ODO Cap

Measurement not influenced by	ODO Cap H0 / H3	Carbon Dioxide
	ODO Cap H2 / H4	Carbon Dioxide lipophilic compounds
Wetted parts resistant to	ODO Cap H0 / H2	Standard cleaning and disinfectant solutions (NaOH, Ethanol, Isopropyl alcohol)
	ODO Cap H3 / H4	Standard cleaning and disinfectant solutions (NaOH, Ethanol and Isopropyl alcohol, active chlorine, chlorine dioxide)
Wetted parts not resistant to	All ODO Caps	Ozone Organic Solvents*

* The contact with gaseous or liquid organic solvents for several minutes should be avoided with ODO Caps H0 and H2 (impact on quality indicator and luminophore). If ODO Caps H3 and H4 are used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

2.2 Electrical safety precautions

CAUTION

Electrical safety precautions:

- Before you remove/disconnect the sensor from the process tank, benchtop, or bioreactor, you must always turn off the power supply and disconnect the cable connector from the sensor.
- Only use the cables provided by Hamilton Process Analytics.
- Do not bend, step on, or place heavy objects on the cable/cord. A damaged cable/cord can pose a shock or fire hazard.
- Do not use a damaged power cord.
- Do not connect the sensor to a power source with an output voltage below or above the range stated in the specifications. For additional information, see the Hamilton Process Analytics website (<https://www.hamiltoncompany.com/process-analytics>). Failure to do so can lead to malfunction or damage to the system or impair the safety of the user.
- The sensor must be installed at a location that is electrically conductive ($< 1 \text{ M}\Omega$).
- We recommend that you inspect the entire grounding (sensor or sensor with reactor) before use and after modifying the setup.

Electromagnetic Compatibility

The sensor is intended for use in an industrial grade electromagnetic environment and comply with the requirements of IEC / EN 61326-1 (2020). Class B for Emissions.

Immunity to proximity fields from RF wireless communications equipment: exceeding to IEC / EN 61326-1 requirements, immunity to cell phone et. Al. frequencies have been tested and passed.

Keep VisiFerm™ RS485-ECS away from other equipment which emits electromagnetic radio frequency fields, and minimize static electricity in the immediate environment of the optical measuring parts.

Earthing

We recommend that you assign the sensor shaft and/or VP8 cable shield to ground or earth (potential equalization), especially in electromagnetically noisy environments. This significantly improves noise immunity and signal quality. The VP8 nut/thread is connected to the metallic housing of the VisiFerm™ RS485-ECS Sensor.

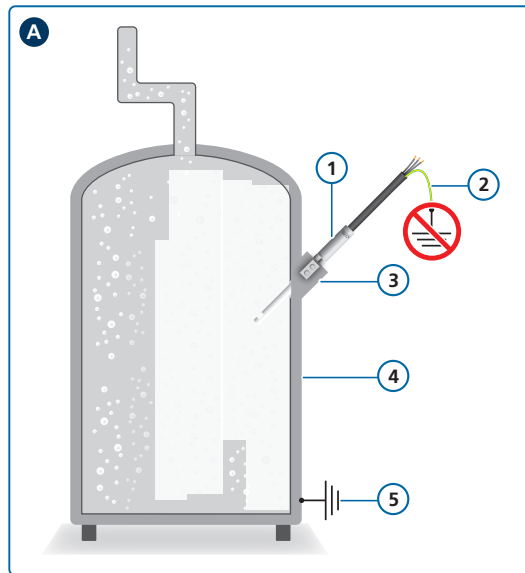
There are two options available for connecting the sensor to the process environment (see Figures 2-1 and 2-2).

NOTICE

- Option A: Metal tank/bioreactor with own earth/ground system (see Figure 2-1)
- Option B: Glass, plastic tank, or benchtop reactor not connected to earth/ground (see Figure 2-2).
- Option B setup has to be applied if the tank is not connected to the earth/ground.

Option A: Metal tank with earth/ground connection

Figure 2-1. Overview of the Dencytee Arc Sensor installed in a metallic bioreactor: Sensor is grounded via the bioreactor [Option A]



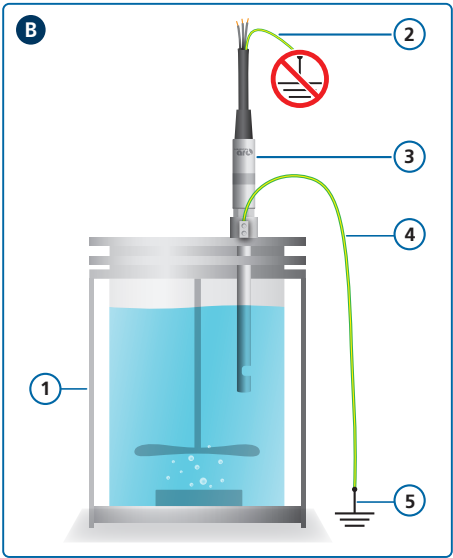
1 VisiFerm™ RS485-ECS Sensor

4 Bioreactor (for example, metal tank)

- 2 Earth/ground cable (yellow/green) for the shaft of the sensor
- 3 Stainless steel PG 13,5 nut/thread to connect the sensor shaft to the metallic tank
- 5 Bioreactor earth/ground

The glass or plastic tank is not connected to the earth. Therefore, it is necessary to connect the sensor shaft via a screw clamp or VP8 cable to the ground/earth. We recommend that you connect the sensor shaft and/or VP8 cable shield to the ground/earth.

Figure 2-2. Overview of the Dencytee Arc Sensor installed in a glass, plastic tank, or benchtop reactor setup without earth/ground connection [Option B]

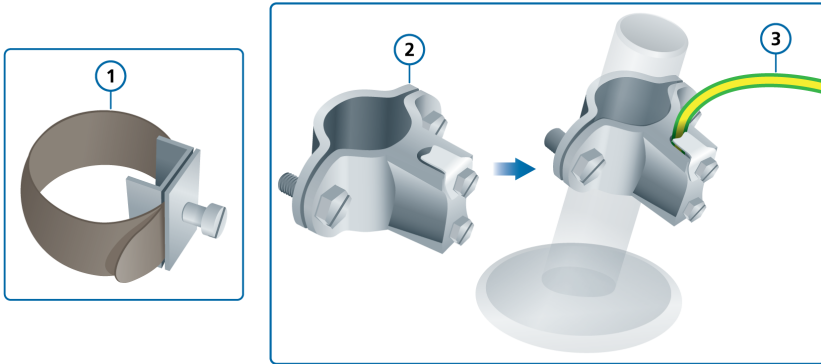


- 1 Glass, plastic tank, or benchtop reactor
- 2 VP8 earth/ground cable (yellow/green)
- 3 VisiFerm™ RS485-ECS Sensor
- 4 Earth/ground cable (green/yellow)
- 5 Metallic earth/ground for the metallic parts (sensor shaft and clamp)

Connecting clamps

Figure 2-3 shows several examples of clamps required for a setup with an earth/ground connection (Clamp 1) or a setup without an earth/ground connection (Clamp 2).

Figure 2-3. Examples of clamps required for installing the sensor to a glass/metal tank reactor, plastic tank, or benchtop reactor



1 Earth/ground strap for pipes

3 Clamp with earth/ground cable for the metallic parts (sensor shaft, clamp, and tank reactor)

2 Earth/ground clamp for pipes

2.3 Chemical, radioactive, and biological hazard precautions

The user is solely responsible for selecting the appropriate biological safety level and implementing the required biosafety measures when working with the VisiFerm™ RS485-ECS Sensor.

WARNING

Always follow maintenance procedures. If working with hazardous liquids, adhere to all cleaning and decontamination procedures. Prevent equipment contact with corrosive media

CAUTION

- *Clean the VisiFerm™ RS485-ECS Sensor immediately if it becomes contaminated with biohazardous, radioactive, or chemical material.*
 - *Failure to observe and follow the maintenance procedures can decrease the reliability and the correct functionality of the system.*
-

3 Product Description

The VisiFerm™ was the first optical dissolved oxygen (DO) sensor for process measurement. With their micro-transmitter, VisiFerm™ RS485-ECS sensors enable direct communication to the process control system via 4-20 mA standard signal with Arc 2G Adapter or digital Modbus. Wireless communication with the Arc Wireless Adapter may be used for monitoring, configuration and calibration, and saves time without compromising the quality of the wired connection.

VisiFerm™ RS485-ECS optical technology improves the measuring performance and simplifies maintenance. Improvements compared to conventional electrochemical (amperometric) sensors include flow independence, rapid start-up with no polarization time, and simplified maintenance.

With the transmitter integrated, VisiFerm™ RS485-ECS sensors provide more reliable measurements directly to your process control system. The micro-transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance. The integrated quality indicator predicts the remaining sensor and cap life time.

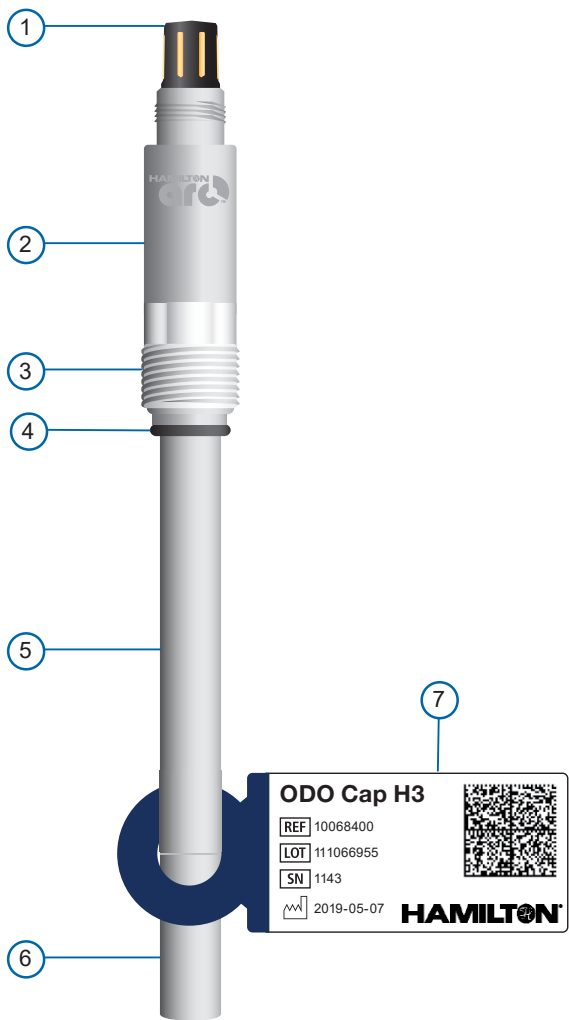
Key benefits include:

- Optical measurement
- No separate transmitter needed
- Simple maintenance with robust industrial design
- Easy to install
- Direct digital Modbus or analog communication to the process control system via 4-20mA standard signal (via Arc Wi 2G Adapter)

3.1 Hardware description

The VisiFerm™ RS485-ECS sensor consists of a sensor head with integrated electronic and a sensor shaft in contact with the measured medium. The sensor shaft is terminated by the optical dissolved oxygen (ODO) cap, carrying the oxygen sensitive luminophore. During development, special attention was paid to an optimum sanitary design. All materials in contact with the solution meet the FDA requirement.

Figure 3-1. VisiFerm™ RS485-ECS Hardware Description.



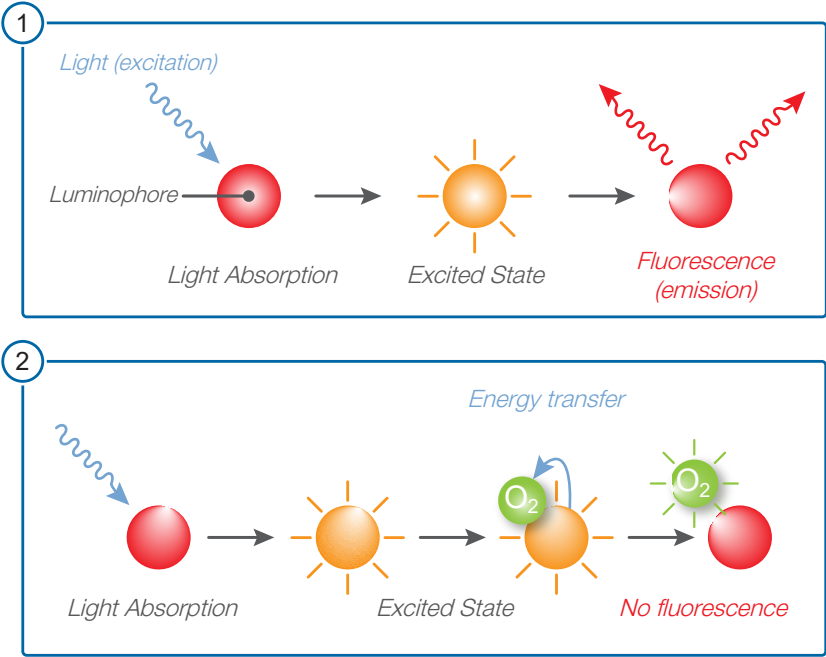
- 1 VP8 Connector
- 5 Sensor shaft with stainless steel heat number and REF

2	Sensor Head with micro-transmitter	6	ODO Cap with oxygen-sensitive luminophore (sensing element), ODO Cap serial number, Ref number and stainless steel heat number
3	Process connection PG 13,5 stainless steel	7	ODO Cap H3 tag/label
4	O-ring		

3.2 Optical DO measurement

The optical measurement principle is based on the so-called luminescence quenching. The luminescence of certain organic pigments (luminophore) is quenched in the presence of oxygen. The luminophore absorbs the excitation light and release a part of the absorbed energy by emission of fluorescence. In the presence of oxygen, energy transfer takes place from the excited luminophore to oxygen. The luminophore does not emit fluorescence and the measurable fluorescence signal decreases.

Figure 3-2. Fluorescence quenching by oxygen



1 Fluorescence process (without oxygen) 2 Quenching in the presence of oxygen

3.3 VisiFerm RS485-ECS with microtransmitter

With the micro-transmitter integrated, VisiFerm™ RS485-ECS sensors offer fully compensated signal directly to the process control system. Communication protocols include analog 4-20 mA (via Arc Wi 2G Adapter). The micro-transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance.

4 Hardware and Software Installation

This chapter provides information and instructions on how to install and set up the VisiFerm™ RS485-ECS Sensor and its hardware as well as the ArcAir application.

4.1 Unpacking the sensor

⚠ CAUTION

Sensor handling and support:

- *Always handle the sensor with care.*
 - *Verify the functionality of the sensor before use if it is accidentally dropped while outside its original Hamilton packaging. For troubleshooting details, see Chapters 6 and 7.*
1. Carefully unpack the VisiFerm™ RS485-ECS Sensor. Inside the packaging, you will find enclosed the VisiFerm™ RS485-ECS Sensor, the Declaration of Quality (DoQ), Material Certificates, and Operating Instructions (see Figure 4-1).
 2. Inspect the sensor for damage or missing parts.

Figure 4-1. VisiFerm™ RS485-ECS Delivery Package



4.2 Configuring the VisiFerm RS485-ECS

Arc sensors require application specific configuration. Following parts are required to configure and calibrate Arc sensors:

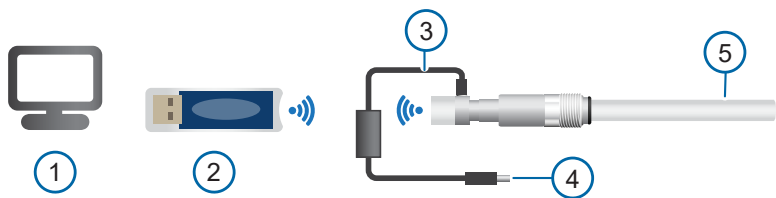
- Arc View Mobile (Ref 10071113) or ArcAir computer Software Solution
- External Power supply with Arc USB Power Cable (Ref 243490-xx)

To configure and set up the Arc sensors at least ArcAir Basic is required. Table 4-1 provides the different ArcAir licenses and its functionality.

Table 4-1. ArcAir Licenses and its Functionality

ArcAir	Read	Calibrate	Configure	Documentation
Basic	✓	✓	✓	-
Advanced	✓	✓	✓	✓

Figure 4-2. VisiFerm™ RS485-ECS Configuration with ArcAir.



4.2.1 Installing ArcAir Basic on a computer

1. Download the Zip file "ArcAir" from the Hamilton webpage www.hamiltoncompany.com (search for ArcAir).
2. Unpack the ZIP-File.
3. Do not plug in the Wireless Converter before the installation of ArcAir is completed.
4. Install "ArcAir" by double clicking "ArcAir.exe" and follow the instructions on the screen.

4.2.2 Connecting an VisiFerm RS485-ECS Sensor to ArcAir

1. Connect a sensors with the power supply, e.g. Arc USB Power Cable Ref 243490-xx.
2. Switch on the mobile's Bluetooth connection or connect a Wireless Converter BT to USB Port of your computer (only for wireless connection).
3. The ArcAir application (see Figure 7) recognizes and displays the connected sensors automatically.

NOTICE

For automatic sensor login a unique and global Operator Level S password for all intelligent sensors is required.

Make sure you have added the same Operator Level S Password for all Arc sensors in the ArcAir application under Backstage/ Settings/Operator Level S Password.

4.2.3 Creating user accounts

1. Start ArcAir application on computer.
2. Click on "Backstage" left upper corner.
3. Select "User Management".
4. Click the "Add" Button for opening the user editor.
5. Type in the user details and password.
6. Select the specific rights for the user.

NOTICE

First user is the administrator and all user rights are assigned as default.

NOTICE

Initial operation of ArcAir is in the laboratory mode as long as no user account is created.

Laboratory mode does not require a login password and enable all features in the installed license version.

4.2.4 Configuring the VisiFerm RS485-ECS Sensor parameters

1. Start the ArcAir application.
2. Select the desired sensor.
3. Open the drawer "Settings" (make sure you have the "Sensor Settings" user right).
4. Configure the sensor.

Table 4-2 provides a description of the settings available.

Table 4-2. Sensor Settings

Parameter name	Description	Default value / setting	Parameter remark	ArcAir configuration location
DO Unit	These are the measurement physical units	• -%vol. • %sat. • ug/l • ppb • mg/l • ppm • mbar • ppm gas*	Required	Measurement ► Values
T unit	These are the temperature physical units	• K • °F • °C	Required	Measurement ► Values
Salinity	The concentration of dissolved oxygen in saturated water is dependent on the salinity	0 mS/cm	Default parameter recommended	Measurement ► Parameter
Air Pressure	The partial pressure of oxygen is proportional to the atmospheric pressure or the pressure of the air supply to the process	1013 mbar	Required, application dependent	Measurement ► Parameter
Measuring interval	The measuring interval can be set between 1-300 sec. The LED flashes once in the set measure interval	3 sec.	Default parameter recommended	Measurement ► Parameter
Moving average	The sensor uses a moving average over the measuring points	10	Default parameter recommended	Measurement ► Parameter

Parameter name	Description	Default value / setting	Parameter remark	ArcAir configuration location
Sensing Material	Sensing Material are different types of ODO Cap which can be set by entering the REF of the ODO Caps	243515	Must application dependent	Measurement ► Parameter
Resolution	The resolution interval can be set between 8-16. The measuring interval is on itself an average over 8-16 individual submeasurements.	8	Default parameter recommended	Measurement ► Parameter

** In calibration mode the sensor will automatically switch to 3 sec sampling rate after the first calibration.*

4.2.5 Configuring the calibration settings

Table 4-3. Calibration Settings

Parameter Name	Description	Default Value	Configuration	Location
Drift DO	High drift will interrupt the calibration process. Warning comes up "drift oxygen"	0.05 %/min	Default parameter recommended	Calibration / Calibration Settings
Drift T	High drift will interrupt the calibration process. Warning comes up "drift temperature"	0.05 K/min	Default parameter recommended	Calibration / Calibration Settings

4.2.6 Configuring the temperature settings of SIP / CIP process

Table 4-4. Temperature Settings of SIP / CIP Process

Parameter Name	Description	Default Value	Configuration	Location
Customer temperature range	User defines temperature range for DO reading. No DO reading above 85 °C possible	-20 °C to 85°C	Default parameter recommended	Status / Quality, Counters and Temperatures
SIP process definition	User defines conditions for the SIP counter	Temp. min: 120 °C Temp. max: 140 °C Time: 20 min	Default parameter recommended	Status / SIP / CIP
CIP process definition	User defines conditions for CIP counter	Temp. min: 80 °C Temp. max. 100 °C Time: 20 min	Default parameter recommended	Status / SIP / CIP

4.2.7 Configuring the analog settings for the process control system

Table 4-5. Analog Settings for the Process Control System

Parameter Name	Description	Default Value	Configuration	Location
Interface Mode	The output of the ECS/ 4-20 mA can be configure linear, bilinear or with a fix value	ECS mode/ 4–20 mA	Default parameter recommended	Interface / Analog Output
Value at 0 nA / 4 mA	Defined measurement value for 0 nA / 4 mA output	0 %sat.	Must application dependent	Interface / Analog Output
Value at 60 nA / 20 mA	Defined measurement value for 60 nA / 20 mA output	300 %sat.	Must application dependent	Interface / Analog Output

Parameter Name	Description	Default Value	Configuration	Location
Mode in event of warning	Current output mode in case of warnings	No output	Default parameter recommended	Interface / Analog Output
Mode in event of error	Current output mode in case of errors	Continuous output	Default parameter recommended	Interface / Analog Output
Output in event of warning	Current output in case of warnings	433 nA / 3.5 mA	Default parameter recommended	Interface / Analog Output
Output in event of error	Current output in case of error	466 nA / 3.5 mA	Default parameter recommended	Interface / Analog Output
Output for T out of limit	Current output in case of temperature out of limit	499 nA / 3.5 mA	Default parameter recommended	Interface / Analog Output

4.2.8 Defining a measuring point name for identification of the process

Table 4-6. Defining Measuring Point Name

Parameter Name	Description	Default Value	Configuration	Location
Measuring point	User can define a sensor name for better identification of the measuring point	10118255-1111-1 23	Optional	Information / Info Userspace

4.3 Installing VisiFerm RS485-ECS in the measuring loop

The VisiFerm™ RS485-ECS Sensor into different process systems. The installation method depends on the type of bioreactor.

Hamilton offers several specialized housings to insert the VisiFerm™ RS485-ECSSensor into different types of bioreactor setups.

4.3.1 Mechanical process connection

The VisiFerm™ RS485-ECS mechanical design is compatible with all Hamilton process housings, including FlexiFit, Retractex, RetractoFit and Hygienic Sockets.

Before installing the armatures, you should test that the seal is tight and the parts are all in working order. Ensure that there is no damage to the sensor or the armature. Check whether all O-rings are in place in the appropriate grooves and are free of damage. To avoid any mechanical damage to O-rings on assembly, they should be slightly greased.

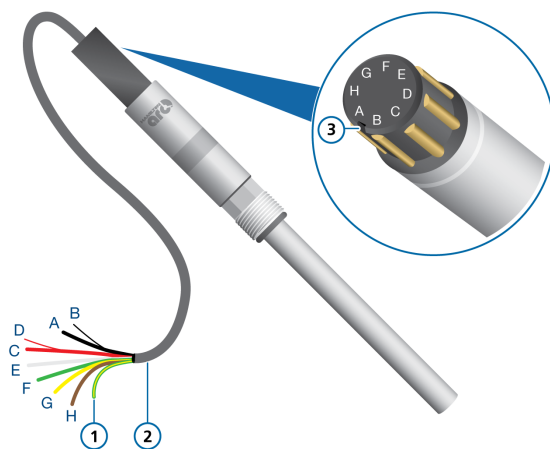
Note that O-rings are wetted parts and greasy compounds must comply to your FDA application needs.

4.3.2 VP8 Pin assignment

Always use Hamilton VP8 sensor cables for safe connection. The VP8 sensor cables are available in different lengths (see Chapter 10). The VisiFerm™ RS485-ECS Sensor is fitted with a VP8 male connector by default.

The VP8 head has a notch to denote the Pin position and prevent incorrect pairing with the cable connectors (see Figure 4-3).

Figure 4-3. VisiFerm™ RS485-ECS Sensor electrical connection: VP8 connector Pin assignment



- | | |
|--|---|
| <p>1 VP8 earth/ground cable (yellow/green)</p> <p>⚠ CAUTION! Do not ground/earth the sensor via the VP8 earth/ground cable if the sensor is grounded via the metallic bioreactor.</p> <p>2 Cable shield (double-shielded coaxial open-end cable and data cable conductor)</p> | <p>3 A notch on the VP8 head for the sensor connector alignment</p> |
|--|---|

Table 4-7. VisiFerm™ RS485-ECS Sensor connector: VP8 Connector Pin Assignment

VP Pin	Function	Double coaxial cable description	Data cable description
A	ECS cathode	Coaxial core, black trans- parent	Yellow
B	ECS Anode (Voltage range may not exceed -2V ... +2V)	Coaxial shield, black	Green
C	Power supply: 24 VDC (10 to 27 VDC) Start-up power: 1.5 W Continuous power consumption: 250 mW	Coaxial core, red trans- parent	Red
D	Power supply: Ground	Coaxial shield, red	Blue
E	Temperature sensor NTC 22 kOhm for ECS	White	Brown
F	Temperature sensor NTC 22 kOhm for ECS	Green	White
G	RS-485 (A)	Yellow	Gray
H	RS-485 (B)	Brown	Pink

 CAUTION

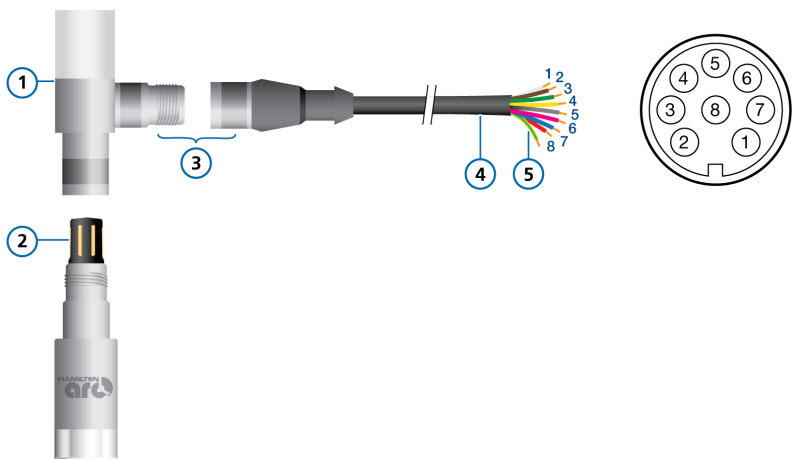
Always use Hamilton sensor cables for safe connection.

4.3.3 Connecting VisiFerm RS485-ECS via 4-20 mA analog interface

Connecting an Arc Wi 2G BT Adapter (REF 243470) to the VisiFerm™ RS485-ECS Sensor head makes it possible to output an analog signal of 4-20 mA from the Modbus digital communication protocol. Always use the Hamilton M12 sensor cable for a safe connection.

The Hamilton M12 sensor cables are available in different lengths (see Chapter 10).

Figure 4-4. Arc sensor setup with Arc Wi 2G BT adapter and M12-8 pole open-end cable



- | | | | |
|---|-----------------------|---|---|
| 1 | Arc Wi 2G BT adapter | 4 | Cable shield |
| 2 | VP8 male connector | 5 | Green/Yellow cable: Connected to the housing including the VP8 female connector |
| 3 | M12-8 pole connection | | |

Table 4-8 provides an overview of the M12 (A coded) Pin assignment for the Hamilton M12-8 pole sensor cable connector.

Table 4-8. M12 (A coded) Pin assignment for the Hamilton M12-8 pole sensor cable connector

M12 Pin	Function	Cable description	Description
1	+4 to +20 mA, #1	White	- The 4-20 mA two-wire interface functions as a current sink and needs to be powered. It regulates the input current according to the measurements of the sensor. - The 4-20 mA two-wire is galvanically isolated from the power supply.
2	-4 to +20 mA, #1	Brown	
3	+4 to +20 mA, #2	Green	
4	-4 to +20 mA, #2	Yellow	
5	RS-485 (A)	Gray	Modbus RTU RS-485
6	RS-485 (B)	Pink	Modbus RTU RS-485
7	GND	Blue	Ground/earth: 0 VDC
8	+24 VDC	Red	Power supply: +10 V to +27 V

! NOTICE! The power supply can be external but not from the PCS.

4.3.4 Electrical connection for analog 4-20 mA connection

The 4-20 mA interface enables direct connection of the VisiFerm™ RS485-ECS Sensor to a data recorder, indicator, control unit, or PCS with an analog Input/Output (I/O). In this configuration, the Wi 2G BT Adapter works as a current sink in a passive state.

Connect the sensor according to the Pin assignments (see Sections 4.3.2 and 4.3.3).

The 4-20 mA interface setup consists of the Arc Wi Adapter and VisiFerm™ RS485-ECS Sensor. The interface has to be configured according to the requirements of the user. The VisiFerm™ RS485-ECS Sensor is pre-configured with default values for the 4-20 mA and measurement unit. .

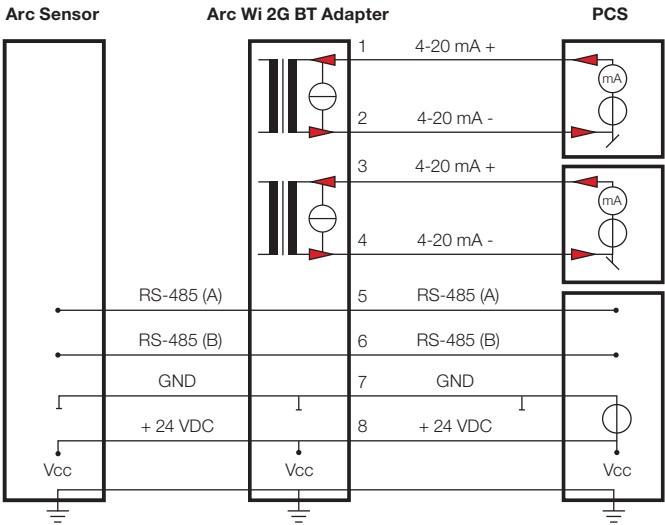
⚠ CAUTION

Wiring and connecting an Arc sensor to a PCS:

The most reliable and safest way to wire an Arc sensor is through a Process Control System (PCS) that has an active 4-20 mA input card. The Arc Wi 2G BT Adapter (REF 243470) includes internal galvanic isolators to improve the analog signal quality and simplify the connection to the PCS.

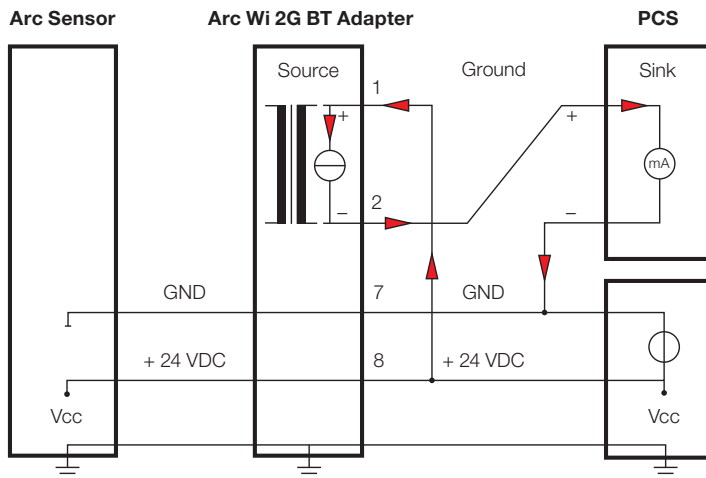
PCS configuration with an active 4-20 mA input card

Figure 4-5. Typical PCS configuration with an active 4-20 mA input card: Setup with an Arc Wi 2G BT Adapter (REF 243470)



PCS configuration with a passive 4–20 mA input card: Sensor configured as the current sink

Figure 4-6. Typical PCS configuration with a passive 4–20 mA input card: Setup with an Arc Wi 2G BT Adapter (REF 243470) if there is no active 4–20 mA connection available



4.3.5 Electrical connection for the ECS interface

The ECS mode enables the simulation of an electrochemical sensor. Thus a VisiFerm™ RS485-ECS sensor can be connected to classical measuring devices instead of amperometric oxygen sensors (Clark cells). Furthermore only the power supply of the VisiFerm™ RS485-ECS sensor is necessary.

NOTICE

ECS signal is only compatible with Arc Wi 1G Adapter.

CAUTION

Do not apply any high voltage (max. 2 VDC) at pin B (anode).

This can result in a destruction of the sensor in ECS mode.

In an electromagnetically noisy environment, it is advisable to assign the sensor's shaft and/or VP cable shield to earth. This significantly improves noise immunity and signal quality.

The NTC temperature sensor attached to the pins E and F is isolated from the integrated electronics and is used for the temperature compensation of the oxygen signal in the measuring device.

Usually classical sensors are operated with a polarization voltage between anode and cathode. This polarization voltage is supplied by the measuring device. VisiFerm™ RS485-ECS can be operated with polarization voltages usual for electrochemical sensors. The sensor is optimized for a polarization voltage of -675 mV.

For adjustment to different measuring devices and/or for simulation of different amperometric sensors the current can be adjusted between 0 and 500 nA.

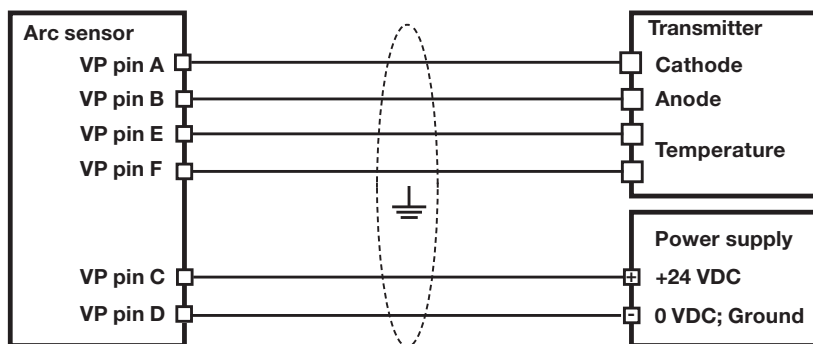
Table 4-9 provides the pin designations of the ECS interface with respect to VP cable conductor colors.

Table 4-9. Pin Designations of the ECS Interface

VisiFerm™ RS485-ECS	VP Pin	Double Coaxial Cable for ECS Mode
ECS Cathode	A	Coaxial core black transparent
ECS Anode (Voltage range may not exceed -2 V ... +2 V)	B	Coaxial shield black
Power supply: + 24 VDC (10 to 27 VDC) Start-up power: 1.5 W Continuous power consumption: 250 mW	C	Coaxial core red transparent
Power supply: Ground	D	Coaxial shield red
NTC 22 kOhm	E	White
NTC 22 kOhm	F	Green

Example of the circuit arrangement

Figure 4-7. Wiring diagram for the ECS interface



4.3.6 Electrical connection for the digital RS-485 interface

The digital RS-485 interface enables communication with the Arc sensor for performing measurements, monitoring the status of the sensor, and changing the configuration parameters of the sensor.

The Arc sensors are always connected to digital controlling devices such as a Modbus slave. The Arc sensors require a power supply via the VP8 Pins **C** and **D** to function correctly (see Figure 4-3).

Additional information: Modbus RTU communication protocol

- The Modbus RTU communication protocol corresponds to the Modbus-IDA standard. For more information, refer to the Modbus organization website (<https://modbus.org/>). The Modbus physical layer is described in detail with requirements on cabling and line termination in the *Modbus Serial line Protocol and Implementation Guide*. For more information on the Modbus physical layer, refer to the *Modbus Serial Line Protocol and Implementation Guide > Technical Resources > Modbus Specifications*.

CAUTION

- All the sensors are delivered with the factory-default setting. Each sensor must be configured for its specific application before first use.
- In an electromagnetically noisy environment, we recommend that you connect the VP cable shield to the earth (see Section 2.2). This significantly reduces noise interference and improves the signal quality.

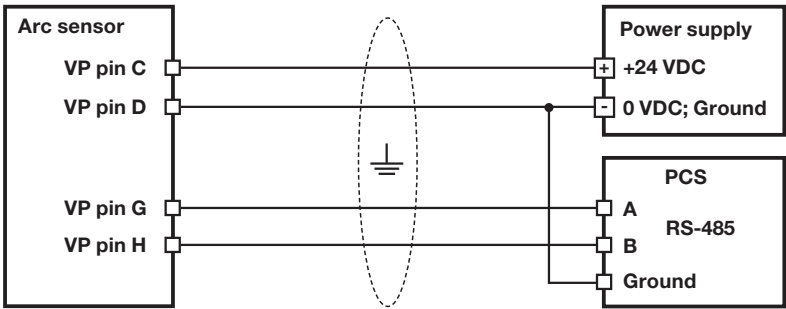
Table 4-10 provides the pin designations of the RS-485 interface with respect to VP cable conductor colors.

Table 4-10. VisiFerm™ RS485-ECS Sensor connector: VP8 Connector Pin Assignment

VisiFerm™ RS485-ECS	VP Pin	Double Coaxial Cable for ECS Mode	Color Data Cable
Power supply: 24 VDC (10 to 27 VDC) Start-up power: 1.5 W Continuous power consumption: 250 mW	C	Coaxial core, red transparent	Red
Power supply: Ground	D	Coaxial shield, red	Blue
RS-485 (A)	G	Yellow	Gray
RS-485 (B)	H	Brown	Pink

Example of the circuit arrangement

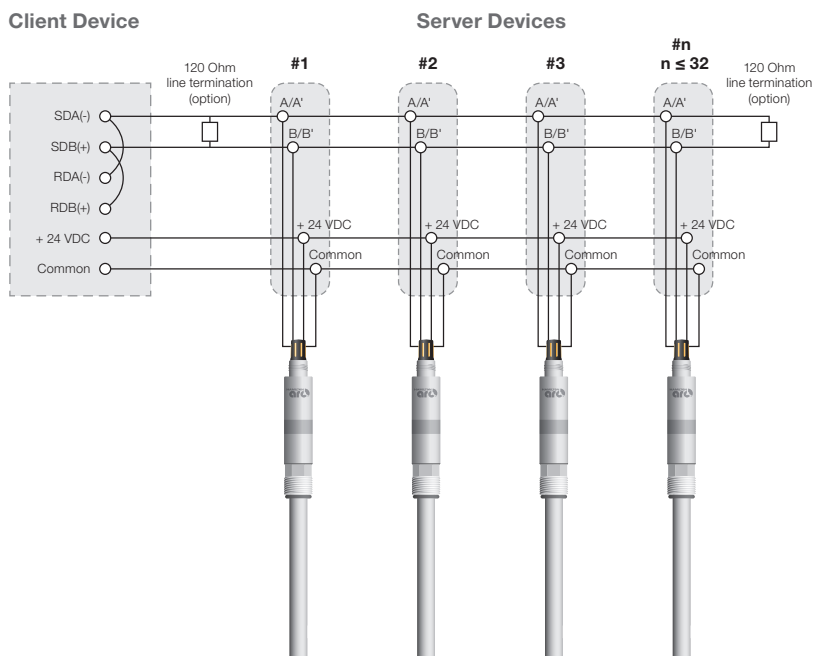
Figure 4-8. Wiring diagram for the RS-485 interface



 **CAUTION**

You must assign a unique Modbus device address to each sensor for the correct communication in the wiring configuration shown in Figure 4-9.

Figure 4-9. Multi-drop bus wiring: Two-wire mode for the Modbus connection

**NOTICE****Modbus communication guidelines:**

- Each sensor functions as a Modbus server.
- Only one sensor can communicate with the client at a time.
- To prevent signal reflection on the lines, use a 120 Ω line termination resistor on each line.
- Signal reflection effects become noticeable with long cables and/or high baud rates.
- The serial Modbus connection between the client's RS-485 port and the sensor interfaces must comply with the EIA/TIA RS-485 standard.

5 Operation

CAUTION

Operational specifications:

Use the sensor only within its specifications. Failure to do so can result in damage or measurement errors. For sensor specification details, visit the Hamilton Process Analytics website (<https://www.hamiltoncompany.com/process-analytics>).

1. Remove the protective caps from the VisiFerm™ RS485-ECS Sensor shaft and the VP 8 sensor head.
2. Check the O-ring on the sensor shaft and verify if the ODO Cap is screwed firmly onto the sensor shaft (see Section Replacing the ODO Cap).

CAUTION

Operating limits and configuration:

- *Do not measure oxygen at a temperature higher than 85 °C. This prevents damage to the optoelectronics and increases the operating life of the sensor.*
 - *When you change the ODO cap type (for example, to the ODO Cap H3), you must configure the reference number of the ODO cap in the Sensing Material register (see Section 4.2.4). This ensures a correct measurement. Firmware version ODOUM101 or a higher version is necessary.*
3. Verify if the sensing material is correct for the ODO Cap type which can be set by entering the Ref number of the ODO Caps.
 4. Verify the functionality of the sensor, including the ODO cap (see Section 6.1).
 5. Calibrate the sensor (see Section 6.3).
 6. Connect the sensor to the process control system (see Section 4.3).
 7. Verify the measurement in air on your control system.
 8. Mount the sensor to the armature or process connection (see Section 4.3).

6 Maintenance

This chapter provides information about the sensor maintenance procedures, including verification, calibration, cleaning, and firmware update instructions.

CAUTION

Safety prerequisite for maintenance:

You must read the Safety Precautions and Hazards in Chapter 2.

All of the procedures in this chapter must be performed by the operator. Contact Hamilton Technical Support for additional maintenance requirements (see Section 7.2).

6.1 Verifying sensor status and ODO cap functionality

1. Power the sensor with the Sensor Power Cable and connect the sensor to ArcAir.
2. Control the traffic lights (see Table 7-1).
3. Refer to the troubleshooting (see Chapter 7) for the next steps if the traffic light is not green.
4. Control the quality of the ODO cap in Sensor Status / Quality Counter and Temperature / Quality Indicator and change the ODO Cap or sensor if required (see Section Replacing the ODO Cap).

NOTICE

Sensor and ODO cap service life and quality:

- The service life of the VisiFerm™ RS485-ECS Sensor highly depends on the specific conditions of the application (e.g., temperature, pressure, and chemicals), which may accelerate the aging of both the sensor and its ODO cap.
- There are three Quality Indicators (QI) for the cap, the sensor, and the measurement quality.
 - ▶ The cap QI shows a Warning at 40% and an Error at 10%.
 - ▶ The sensor QI shows a warning at 10%.
 - ▶ The measurement QI does not have a numerical value but a description that depends on the sensor QI and the cap QI.
- The "Maintenance required" warning message remains active while the sensor QI is less than 10% or the cap QI is less than 40%.
- After you replace the ODO cap or the sensor, verify that the measurement quality status is Green. This status depends on both the sensor QI and the cap QI.

6.2 Replacing the ODO cap

⚠ CAUTION

ODO Cap removal: Avoid mechanical tools

Do not use mechanical tools to remove the ODO Cap from the VisiFerm™ RS485-ECS Sensor shaft.

NOTICE

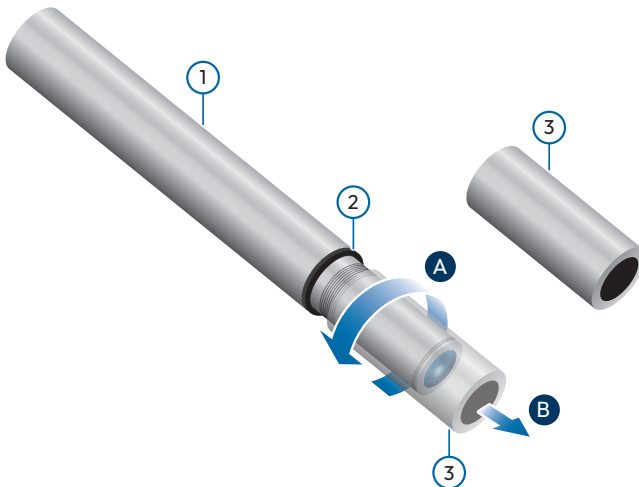
Tip for removing firmly mounted ODO Cap from the sensor:

If the ODO Cap is mounted very firmly, use a silicone tube or grip mat placed between your fingers and the stainless steel shaft of the sensor and the ODO cap to obtain a better, non-slip grip.

To replace the ODO Cap, follow these steps:

1. Unscrew the old ODO Cap (3) from the Sensor Shaft (1) (see Figure 6-1).
2. Exchange the O-ring: Replace the old O-ring (2) with a new one.
3. Screw the new ODO Cap firmly onto the Sensor Shaft (1) to ensure a tight seal.
4. Calibrate the VisiFerm™ RS485-ECS Sensor.

Figure 6-1. Replacement of the ODO Cap for the VisiFerm™ RS485-ECS Sensor



- 1 Sensor shaft
- 2 O-ring

- 3 ODO cap

6.3 Calibration

The VisiFerm™ RS485-ECS sensors provide two kinds of sensor calibration: automatic standard calibration, and product calibration. The automatic standard calibration and the product calibration may be performed using ArcAir (see Section 4.2).

6.3.1 Automatic standard calibration with ArcAir

VisiFerm™ RS485-ECS sensors are calibrated at two points: in air and in an oxygen-free environment. During calibration, the sensor controls automatically the stability of the oxygen and temperature signals.

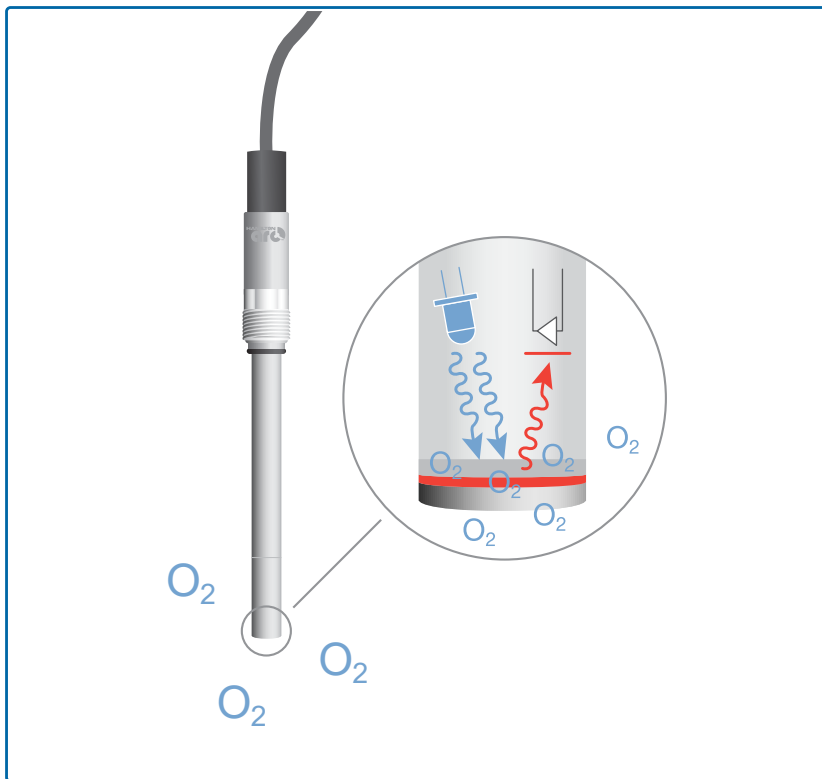
NOTICE

For greater measurement accuracy ensure that temperature difference between calibration medium and process medium is minimal.

6.3.2 Calibration in air (Calibration Point Air)

1. Make sure temperature, humidity and pressure values are constant.
2. Power the VisiFerm RS485-ECS and connect to ArcAir via the Arc Wireless Converter BT.
3. Select the sensor in the **Sensor** list.
4. Open the **Calibration** tab.
5. Select **Calibration Point Air**.
6. Click **Start** to start the calibration wizard.
7. Follow the instructions on the screen to complete the sensor calibration process.

Figure 6-2. Calibration Setup in Air; Pressure and humidity compensation required



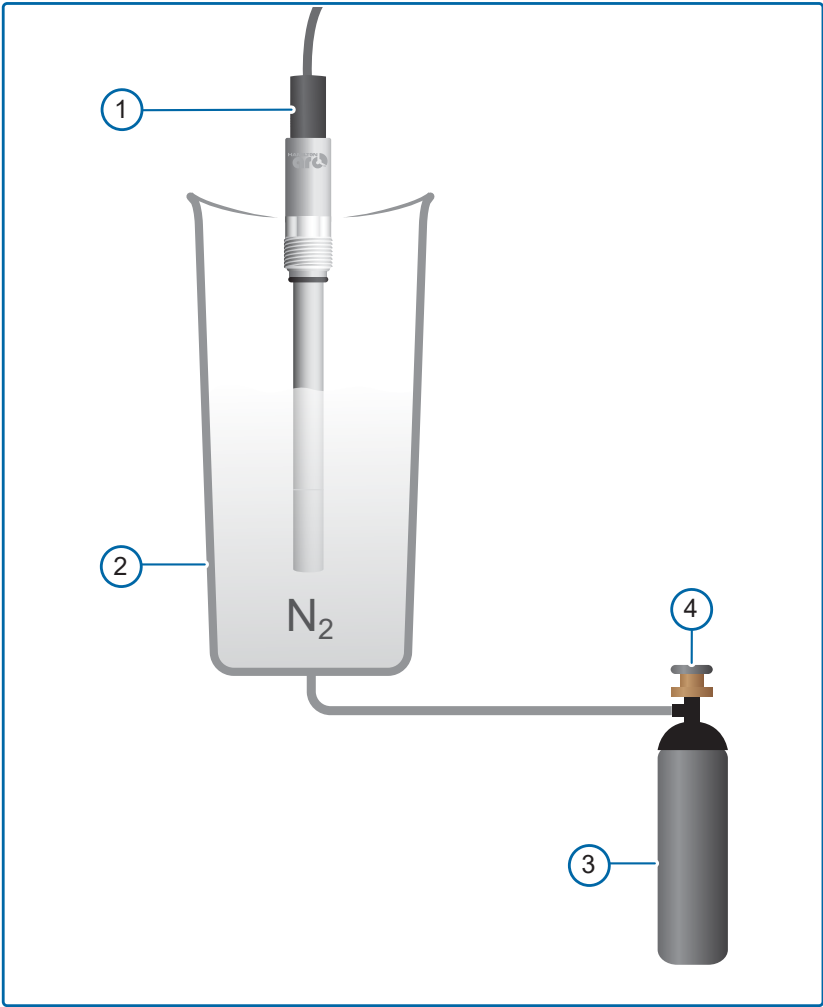
NOTICE

- The value of the saturated oxygen concentration at different temperatures, different pressures and air humidity play an important role for the calibration of dissolved oxygen.
- For an accurate calibration Hamilton strongly recommend to enter the atmospheric pressure and humidity values in the ArcAir calibration, product calibration and verification wizards.

6.3.3 Zero-point calibration (Point Zero Oxygen)

1. Install the sensor into the calibration station and connected the Nitrogen calibration gas (see Figure 6-3).
2. Power the VisiFerm RS485-ECS and connect to ArcAir via the Arc Wireless Converter BT.
3. Select the sensor in the sensor list.
4. Open the Calibration tab.
5. Select Zero Point calibration.
6. Immerse the sensor into an oxygen-free environment for e.g. nitrogen. Verify that the flow rate does not exceed 0.5 L/min and avoid overpressure.
7. Click Start to start the calibration wizard.
8. Follow the instructions on the screen.

Figure 6-3. Zero Point Calibration Setup



- | | | | |
|---|---|---|---|
| 1 | Sensor for calibration in zero oxygen | 3 | Nitrogen bottle with purity of 5.0 |
| 2 | Tube: on the top open (no overpressure) | 4 | Valve for setting the flow of 0.5 L/min |

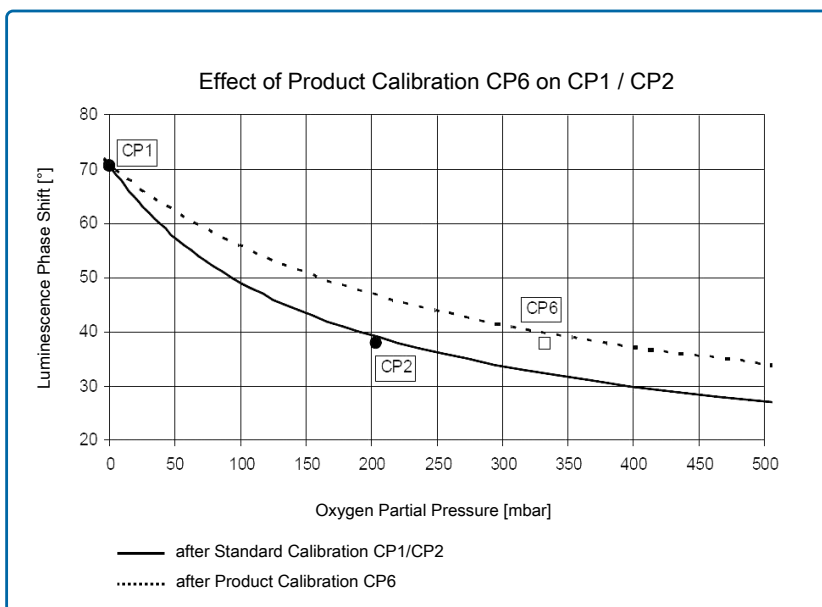
6.4 Product calibration

The product calibration is an in-process calibration procedure in order to adjust the measurement to specific process conditions. Product calibration is an additional calibration procedure to a standard calibration.

If product calibration is activated, the VisiFerm™ RS485-ECS calibration curve is calculated from the data of last calibration at point 1 and from the data of the product calibration (see Figure 6.4). In order to restore the original standard calibration curve, the product calibration can be at any time by selecting on the Product calibration command "Cancel". A new standard calibration cancels a product calibration as well.

Figure 6.4 displays the effect of a product calibration (CP6) on an existing standard calibration function based on the Zero Point Calibration (CP1) and the Air Calibration (CP2).

Figure 6-4. Effect of Product Calibration (CP6) on CP1 / CP2



NOTICE

The product calibration is possible for DO values in the range of 2 to 55 %-vol (20 – 550 mbar pO₂).

A product calibration is performed as follows:

1. Connect one of the VisiFerm™ RS485-ECS sensor with the power supply, e.g. USB Power Cable Ref 243490 and install a Wireless Converter BT Ref 242333.
2. Select the desired sensor from the sensor list.
3. Go to "Process Settings".
4. Click "Start" to start the product calibration wizard.
5. Follow the instruction on the screen.

NOTICE

Alternatively, the product calibration may be performed with a field device on side the measuring point.

6.5 Cleaning

This chapter outlines a manual cleaning procedure for the care and maintenance of optical dissolved oxygen (ODO) sensors including a procedure for the cleaning the sensing membrane in particular.

CAUTION

- *Only authorized/trained service personnel can install, operate, clean, calibrate, or maintain the VisiFerm™ RS485-ECS Sensor or do other service-related tasks.*
- *Always make sure that the system is depressurized and cold, and that no process medium can be accidentally spilled before you remove the sensor from the measuring system.*
- *Always wear protective eyewear and gloves before you remove the sensor from the system, for example, cleaning the bioreactor.*
- *Do not use abrasive tissues or cleaning agents/solutions other than the recommended standard cleaning agents/solutions to clean the sensor.*
- *You must decontaminate every sensor or product before shipping it back to Hamilton Process Analytics for repair.*

Cleaning the sensor

To clean/decontaminate the sensor, follow these steps:

1. Remove sensor from the measuring setup.
2. Check if the ODO Cap is mounted firmly on the shaft.
3. Soak a dust-free cloth or tissue paper with water and wipe the wetted parts with it.
Thoroughly rinse the wetted parts and the sensing membrane with deionised water afterwards.

-
4. Dry the wetted parts with a clean dust-free cloth or tissue and store the sensor in dry and dark conditions (ODO Caps are light-sensitive).
 5. If the sensing-membrane on the front of the cap is contaminated with oil, grease or other organic matter, soak a clean dust-free cloth with isopropyl alcohol.
 6. Rinse the sensor membrane with deionized water and gently wipe over the membrane if any residual isopropyl alcohol remains.
 7. After cleaning always do a new calibration before use the sensor in your process for measurements (see Section 6.3).

7 Troubleshooting

This chapter provides information on troubleshooting guidelines, tips for self-diagnosis, technical support contact details, and Hamilton's product return procedures.

You must do periodic maintenance routines to ensure safe and reliable operation and measurement with the Arc sensor and its accessories. Make sure that there is no mechanical damage to the sensor tip.

This chapter provides information on troubleshooting guidelines, tips for self-diagnosis, technical support contact details, and Hamilton's product return procedures.

You must do periodic maintenance routines to ensure safe and reliable operation and measurement with the Arc sensor and its accessories. Make sure that there is no mechanical damage to the sensor tip.

The status/condition of the sensor is indicated by the traffic light identification (ID) system (see Table 7-1).

Table 7-1. Sensor status indicator in ArcAir application: Overview of the traffic light ID system

Sensor status indicator: Traffic light ID system	Description
Green 	• The sensor is functioning correctly. • No errors or warnings have been registered.
Yellow 	• At least a warning has been registered. • Verify the warnings of the sensor under Sensor Status.
Red 	• At least an error has been registered. • Verify the error of the sensor under Sensor Status.

Sensor status indicator: Traffic light ID system	Description
--	-------------

Gray

The sensor is offline.



NOTICE

The quality of the sensor is affected by the following factors:

- Warnings
- Errors
- Verification procedure running in ArcAir application.

To resolve a warning or an error, follow these steps:

1. Connect the VisiFerm™ RS485-ECS Sensor by using the Arc USB Power Cable (REF 243490) on a standard USB port.
2. Investigate and resolve the warning or error under the **Sensor Quick View** or **Sensor** list in the ArcAir application.

7.1 Sensor self-diagnostic

VisiFerm™ RS485-ECS sensors provide a self-diagnostic functionality to detect and identify the most common sensor malfunctions.

Digital Modbus, may provide warning and error messages. The settings of the analog 4–20 mA interface can be configured according to the NAMUR recommendations to indicate an abnormal event (see Section 4.3.3).

Use ArcAir for monitoring the sensor status and for troubleshooting. The following types of messages are provided by the self-diagnosis function.

NOTICE

- **Errors** cannot be ignored and corrective action is immediately necessary.
- **Warnings** can be ignored but the warning will be displayed continuously until the corrective action is successfully completed.
- For additional information about the sensor status and the diagnostics features refer to the sensor operation instruction manual or the programmer's manual.

7.1.1 Warnings associated with sensor use

The status indicator of the sensor lights up **Yellow** (●) when a warning is registered.

Warning associated with routine measurements

Table 7-2. Overview of the warnings associated with sensor use and routine measurements

Warning Description	Possible Cause	Corrective Action
DO reading below the lower limit	The oxygen reading is too low (DO < 0%-sat).	Make a new zero-point calibration (see Section 6.3.3).
DO reading above the upper limit	The oxygen reading is too high (DO > 300 %-sat).	• Make a new calibration in oxygen saturated medium (see Section 6.3.3). • If not successful, replace the sensor cap (see Section Replacing the ODO Cap).
Temperature (T) reading below the lower limit	The temperature is below the user-defined measurement temperature range. ! NOTICE! The sensor cannot perform DO readings if the measurement temperature is outside the defined range.	Make sure the defined measurement temperature is within the defined range.
Temperature (T) reading above upper limit	The temperature is above the user-defined measurement temperature range. ! NOTICE! The sensor cannot perform DO readings if the measurement temperature is outside the defined range.	Make sure the defined measurement temperature is within the defined range.

Warning Description	Possible Cause	Corrective Action
Measurement not running	- The measurement interval is set to 0. - The temperature measurement is outside the user-defined temperature range.	- Make sure the measurement interval is > 0. - Make sure the defined measurement temperature is within the defined range.

Warning associated with the calibration

Table 7-3. Overview of the Warnings associated with the calibration

Warning Description	Possible Cause	Corrective Action
DO calibration recommended	DO measurement out of range	Perform a calibration in order to ensure reliable measurement (see Section 6.3)

Warnings associated with configuration

Table 7-4. Overview of the Warnings associated with configuration

Warning Description	Possible Cause	Corrective Action
ECS value above upper limit	Above allowed limit.	- Reconfigure and adjust installation again (see Section 4.2). - Contact Hamilton Technical Support (see Section 7.2).
4-20 mA value below 4 mA on the PCS	The measurement value is below the lower limit of the 4-20 mA interface output.	Reconfigure the 4-20 mA interface (see Section 4.2.7)
4-20 mA value above 20 mA on the PCS	The measurement value is above the the upper limit of the 4-20 mA interface output.	Reconfigure the 4-20 mA interface (see Section 4.2.7)

Warnings associated with the hardware

Table 7-5. Overview of the Warnings associated with the hardware

Warning Description	Possible Cause	Corrective Action
ECS current set point not met	Not possible to control ECS.	- Control wiring again (see Section 4.3.5). - Contact Hamilton Technical Support (section 7.2).
4–20 mA current set-point not met on the PCS	The 4–20 mA interface is not able to regulate the current requested for the current measurement value according to your 4–20 mA interface configuration.	Check the 4–20 mA wiring and supply voltage (see Sections 4.3.3 and 4.3.4)
Sensor supply voltage too low	The sensor supply voltage is below 10 V.	Check and verify the output voltage of the sensor.
Sensor supply voltage too high	The sensor supply voltage is above 27 V. Please check your power supply.	Check and verify the input voltage of the sensor.
DO replace sensor cap	The Quality Indicator (QI) of the sensor cap is below 40%. The quality of the ODO Cap is sufficient for reliable measurement, but a replacement of the ODO Cap must be considered.	Replace the ODO Cap and calibrate the cap sensor (see Sections Replacing the ODO Cap and 6.3).
Replace sensor recommended	The Quality Indicator (QI) of the sensor is below 10%. The quality of the sensor is sufficient for reliable measurement, but a replacement of the sensor must be considered.	Replace the sensor.

7.1.2 Errors associated with sensor calibration and routine measurements

The status indicator of the sensor lights up **Red** (●) when a warning is registered.

Errors associated with the Measurement

Table 7-6. Overview of the Errors associated with the measurement

Error Description	Possible Cause	Corrective Action
DO reading failure	• Sensor cap is missing • Sensor is broken.	• Place sensor cap and calibrate the cap sensor (see Sections Replacing the ODO Cap and 6.3). • Replace Sensor.
DO p(O ₂) exceeds air pressure	Measured partial pressure of oxygen is higher than the air pressure set by the operator.	Reconfigure the air pressure parameter (see Section 4.2.4).
Red channel failure	Measurement channel failure.	Contact Hamilton Technical Support (see Section 7.2).
Temperature reading far below min	The measured temperature is below the operation temperature	Increase the minimum temperature setting.
Temperature reading far above max	The measured temperature is above the operation temperature	Increase the maximum temperature setting.

Errors associated with configuration

Table 7-7. Overview of the Errors associated with configuration

Warning Description	Possible Cause	Corrective Action
4-20 mA value below 4 mA on the PCS	The measurement value is below the lower limit of the 4-20 mA interface output.	Reconfigure the 4-20 mA interface (see Section 4.2.7)
4-20 mA value above 20 mA on the PCS	The measurement value is above the the upper limit of the 4-20 mA interface output.	Reconfigure the 4-20 mA interface (see Section 4.2.7)

Errors associated with the hardware

Table 7-8. Overview of the Errors associated with the hardware

Error Description	Possible Cause	Corrective Action
Temperature (T) sensor defective	The internal temperature sensor is defect.	Contact Hamilton Technical Support (see Section 7.2).
DO sensor cap missing	The DO sensor cap has been removed.	- Do not immerse the sensor in a measurement solution. - Mount an ODO Cap and calibrate the sensor prior measurement (see Chapter 6).
DO sensor cap replace	Sensor cap has reached lower level of cap quality indicator.	Replace the ODO Cap and calibrate the cap sensor (see Sections Replacing the ODO Cap and 6.3).
4-20 mA current set-point not met on the PCS	The 4-20 mA interface is not able to regulate the current requested for the current measurement value according to your 4-20 mA interface configuration.	Check the 4-20 mA wiring and supply voltage (see Sections 4.3.3 and 4.3.4)
EEPROM comm. (I2C) error Userend	EEPROM internal communication error.	Reset the sensor and try again.
Internal Communication (I2C) failure Userend	Internal I2C communication error.	Reset the sensor and try again.
Internal Communication failure to Frontend	No communication between Frontend and Userend.	Reset the sensor and try again.
Stack Overflow	Internal memory failure.	- Reset the sensor and try again. - Contact Hamilton Technical Support (see Section 7.2).

7.2 Request for technical support

If a problem persists after you have attempted to correct it, contact Hamilton Technical Support via email (contact.pa.ch@hamilton.ch) or phone (+41-58-610-10-10).

7.3 Returning the sensor for investigation

WARNING

Sensor decontamination and return procedure:

- Decontaminate the VisiFerm™ RS485-ECS Sensor to remove hazardous materials such as radiation, chemicals, or infectious agents before returning the sensors to Hamilton.
- Provide a complete description of any hazardous materials that have contacted the sensor.

CAUTION

Returning sensors to Hamilton: Policy and procedure

- *Do not return a sensor to Hamilton without a valid Return Merchandise Authorization (RMA) number. The RMA number ensures that your sensor can be tracked and handled by the correct department.*
- *VisiFerm™ RS485-ECS Sensors returned without an RMA number will be sent back to the customer without investigation.*

Before returning an Arc sensor to Hamilton for repair, contact our Technical Support and request a Return Material Authorization (RMA) number (see Section 7.2).

8 Disposal

 CAUTION

Product disposal and recycling:

- Do not dispose of products at an unsorted waste disposal point.
- Hamilton products that are worn out or no longer required must be sent to a dedicated collection point for electrical and electronic devices.

NOTICE

Return product to Hamilton for disposal:

You can also send the product to Hamilton for disposal.

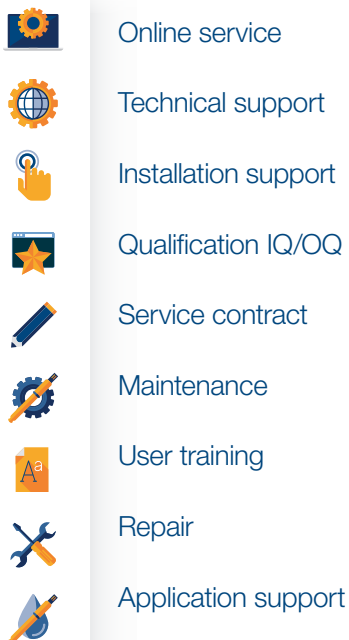
Table 8-1. Symbols used on the product labels and packaging

Symbol	Definition
	Dispose of in accordance with the EU Directive 2012/19/ EU or WEEE (Waste Electrical and Electronic Equipment)
	有關危險物質的列表，請參閱 Hamilton Process Analytics 符合性聲明。如需了解更多信息，請訪問 Hamilton 的網站：www.hamiltoncompany.com。 For a list of hazardous substances, see the Hamilton Process Analytics Declaration of Conformity. For additional information, visit the Hamilton website: www.hamiltoncompany.com.

9 Services

This chapter provides an overview of the services provided by Hamilton Process Analytics (see Figure 9-1).

Figure 9-1. Overview of the services provided by Hamilton Process Analytics



10 Ordering Information

This chapter provides an overview of the different types of VisiFerm™ RS485-ECS Sensors and accessories that are available to order.

10.1 VisiFerm RS485-ECS



10118255 VisiFerm RS485-ECS					
10118255 –	Code	Interface			
	1	RS485-ECS			
	↓	Code	Sensor length		
		1	120		
		2	160		
		3	225*		
		4	325		
		5	425		
		↓	Code	ODO Cap	
			1	H0	
			2	H2	
			3	H3	
			4	H4	
		↓	Code	Wetted Parts	
			1	EPDM	
					Orderingcode

* The VisiFerm™ RS485-ECS 225 Sensor has an actual shaft length of 215 mm. This ensures that the sensor can be effectively flushed in a removable housing such as Retractex.

10.2 Parts, accessories, and software

 **CAUTION**

Use original spare parts only:

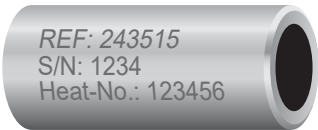
The following components must be replaced with original spare parts only.

10.2.1 ODO caps - previous generation

ODO Cap H0

For general application in biotechnology, water treatment and monitoring as well as in breweries, wineries and soft drink processing.

Figure 10-1. ODO Cap H0

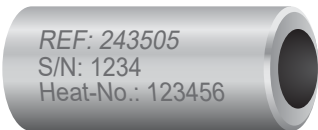


REF	Product Description	Wetted Materials
243515	ODO Cap H0	Stainless steel 1.4435 Silicone (FDA approved and USP Class VI)

ODO Cap H2

For fermentation processes where sterilization in place (SIP) is performed in media containing higher amounts of lipophilic compounds. It comes with a hygienic design.

Figure 10-2. ODO Cap H2



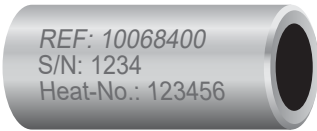
REF	Product Description	Wetted Materials
243505	ODO Cap H2	Stainless steel 1.4435 PTFE (USP Class VI)

10.2.2 ODO caps - new generation

ODO Cap H3

For general application in biotechnology, water treatment and monitoring as well as in breweries and wineries.

Figure 10-3. ODO Cap H3

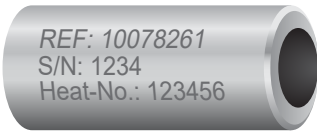


REF	Product Description	Wetted Materials
10068400	ODO Cap H3	Stainless steel 1.4435 Silicone (FDA and USP Class VI)

ODO Cap H4

For fermentation processes where sterilization in place (SIP) is performed in media containing higher amounts of lipophilic compounds. It comes with hygienic design.

Figure 10-4. ODO Cap H4



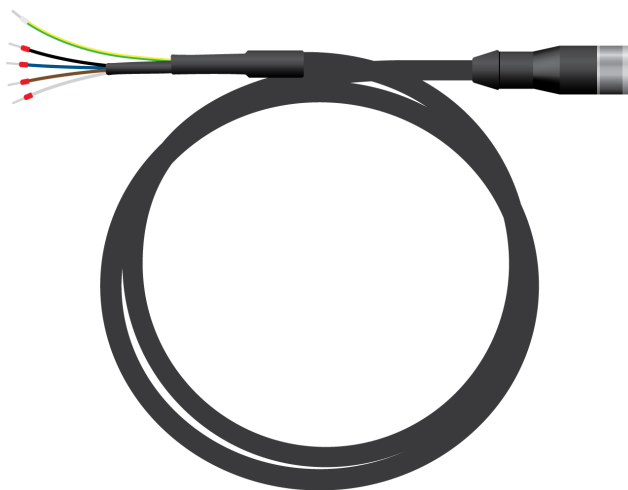
REF	Product Description	Wetted Materials
10078261	ODO Cap H4	Stainless steel 1.4435 PTFE (USP Class VI)

10.2.3 Accessories

M12-8 Pole Open-end Cable

The M12 8-pin sensor cable with open ends serves as an important interface between the sensor and various data processing devices. It enables the sensor to be connected to systems such as data recorders, display devices, control units, or process control systems (PCS) with analog inputs/outputs (I/O).

Figure 10-5. M12 8-Pole with open-end cable



REF	Product description	Length (m)
355320	M12 8-pole / open-end cable	3 m
355321	M12 8-pole / open-end cable	5 m
355322	M12 8-pole / open-end cable	10 m

Sensor Data Cable: VP8 Double Coaxial / Open-end Data Cable

The VP8 Sensor Data Cable with open-end wires is designed to enable interface connection between the sensor and a data recorder, indicator, control unit, or PCS with an analog I/O (input/output).

Figure 10-6. Arc sensor data cable: VP8 double coaxial / open-end wiring



Table 10-1. VP8 double coaxial / open-end data cable

REF	Product description	Length (m)	Interface
355263	VP8 double coaxial / open-end data cable	1 m	4-20 mA/Modbus
355264	VP8 double coaxial / open-end data cable	3 m	4-20 mA/Modbus
355265	VP8 double coaxial / open-end data cable	5 m	4-20 mA/Modbus
355266	VP8 double coaxial / open-end data cable	10 m	4-20 mA/Modbus
355267	VP8 double coaxial / open-end data cable	15 m	4-20 mA/Modbus
355268	VP8 double coaxial / open-end data cable	20 m	4-20 mA/Modbus

Sensor Data Cable: VP8 Open-end / 4-Wire Data Cable

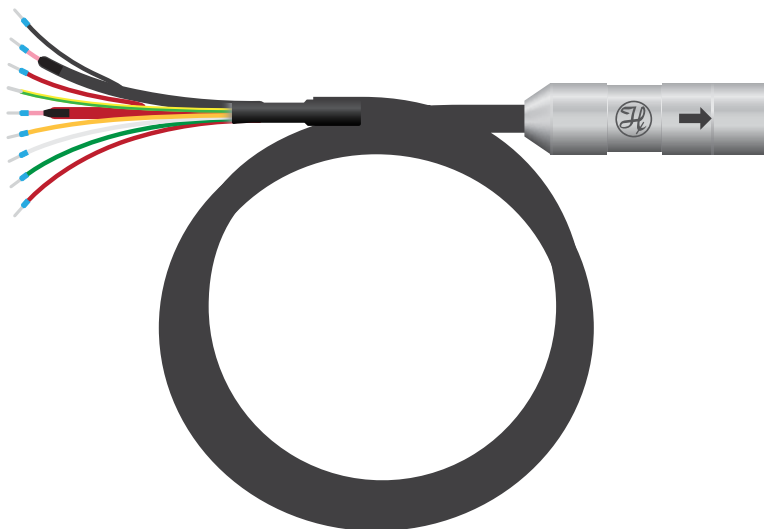
Table 10-2. VP8 open-end / 4-wire data cable

REF	Product description	Length (m)
10109026	VP8 open-end / 4-Wire data cable	1 m
10109251	VP8 open-end / 4-Wire data cable	3 m
10109250	VP8 open-end / 4-Wire data cable	5 m

Sensor cable VP8

The VP8 Sensor Cable with open-end wires is designed for connection to a data recorder, indicator, control unit or PCS (Process Control System) with analog I/O (input/output).

Figure 10-7. Arc sensor cable with VP8 connector and open-end wiring



REF	Product description	Length (in meters)	Interface
355217	Sensor cable VP8	1 m	ECS mode
355218	Sensor cable VP8	3 m	ECS mode
355219	Sensor cable VP8	5 m	ECS mode
355220	Sensor cable VP8	10 m	ECS mode
355221	Sensor cable VP8	15 m	ECS mode
355222	Sensor cable VP8	20 m	ECS mode

Arc USB power cable

The Arc USB Power Cable provides power via a USB port for the Arc sensors and digital communication with the ArcAir application for monitoring, configuration, calibration, and firmware updates.

Figure 10-8. Arc USB Power Cable



REF	Product description
243490-01	Arc USB power cable: USB/VP8 for direct connection to the sensor
243490-02	Arc USB power Cable: USB/M12-8 pole for connection to the sensor with Arc Wi 2G BT Adapter
242176	Arc Sensor Cable VP 8
355339	Arc Wi 2G BT Service Cable 2 m
355289	Arc Wi 2G Service Cable 2 m

NOTICE

An additional power supply is supplied with the Arc USB Power Cable in case the PC/ Notebook does not provide enough power to power the sensor. A PC/Notebook with a USB 2.0 port or higher can provide sufficient power to the sensor.

Phased Out / Discontinued Products:

- Arc Wireless BT Converter (REF 243499)
- Arc Wireless BT Converter Advanced (REF 242333)

The Arc Wireless BT Converter (REF 243499) and Arc Wireless BT Converter Advanced (REF 242333) are no longer offered by Hamilton Process Analytics. We have phased out (discontinued) these two products.

The latest version of the ArcAir application with Bluetooth® update can be downloaded from the Hamilton Process Analytics website (<https://www.hamiltoncompany.com/process-analytics>). This software update is available for free.

If you require the Arc Wireless BT Converter Advanced (REF 242333) and have ArcAir version 3.8.2 or higher installed, you can use the ArcAir Advanced USB License Key (REF 10155643) to activate the functionality.

NOTICE

Arc sensors configuration via PC/Notebook internal Bluetooth®:

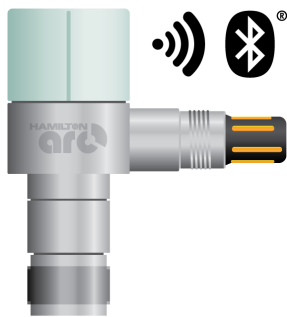
Arc sensors can be configured by using the internal Bluetooth® functionality on a PC / Notebook:

- **Software requirements:** ArcAir versions 3.8.2 and higher support this functionality.
- **Hardware support:** The Arc sensor configuration can be done using the internal Bluetooth® chip on the PC or by connecting a third-party USB Bluetooth® device.

Arc Wi 1G BT adapter

The Arc Wi 1G BT Adapter enables wireless communication between the Arc sensors and mobile devices via Bluetooth®.

Figure 10-9. Arc Wi 1G BT adapter



REF	Product description
243460	Arc Wi 1G BT adapter

Arc Wi 2G BT Adapter

The Arc Wi 2G BT Adapter converts Modbus digital communication protocol to 4-20 mA signals and enables Bluetooth® communication for sensor configuration and monitoring.

Figure 10-10. Arc Wi 2G BT adapter



REF	Product description
243470	Arc Wi 2G BT adapter

Basic Arc view tablet for non-Ex environments

The pre-configured Basic Arc view tablet is Hamilton's solution for monitoring measurement values, calibrating Arc sensors, and configuring various parameters with the unified user interface for pH, DO, Conductivity, VCD, TCD, and ORP (see Figure 10-11).

The Basic Arc view operates on the Samsung Galaxy Tab Active tablet and is pre-configured with the Basic ArcAir software and an App Blocker application.

The Basic Arc view tablet comes with a Power Supply Cable, a Manual, and Hamilton's Quick Start Guide.

Figure 10-11. Basic Arc view tablet for non-Ex environments



REF	Product description
10071111	Basic Arc view tablet for non-Ex environments

Arc View Mobile Advanced for non-Ex environments

The pre-configured Arc View Mobile, Hamilton’s mobile solution for monitoring measurement values, calibrating Arc sensors and configuring various parameters with the unified user interface for pH, DO, Conductivity and ORP. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with the ArcAir advanced application, including features for CFR 21 Part 11 and Eudralex Volume 4 Annex 11 compliance, app blocker application, power supply cable, instruction manual and Hamilton’s quick guide.

Figure 10-12. Advanced Arc view tablet for non-Ex environments



REF	Product description
10071113	Arc View Mobile Advanced for non-Ex environments

10.2.4 ArcAir application

ArcAir application download

Download the ArcAir application from the App Store or Google Play.

Figure 10-13. ArcAir application download from the App Store or Google Play





More information and free software simulation:
www.hamiltoncompany.com/process-analytics



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